

Readability and suitability of online material
relating to sudden sensory neural hearing loss
(SSNHL)

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Abstract

Purpose: Previous research has found that online hearing health information is hard to read and of poor to adequate suitability and quality. This study investigated the readability and suitability of online information relating to SSNHL.

Methods: Common search terms were obtained from participants who were asked what they would search if they woke up with a sudden hearing loss. These search terms were entered into Google domains of countries where English is spoken. After duplicates were removed a total of 41 webpages were analysed. Webpages related to SSNHL from the first page of the Google search results were analysed. Webpages were analysed for both readability and suitability. Readability was measured using the mean readability scores for each webpage as measured using the FOG, SMOG and F-K readability formulas. Suitability was measured using the DISCERN, PEMAT and PL.

Results: Online health information relating to SSNHL had high readability and had “poor”-“adequate” suitability. The mean understandability score was 69% and the mean actionability score was 33% when rated using the PEMAT. The mean score from the PL was 15/20. The mean score from the DISCERN was 2.4. The mean RGL was 10.91, which is well above the recommended RGL <6. There was an even distribution of webpages based on location, however there were more “commercial” webpages than “other” webpages. “Commercial” webpages had a lower score for actionability compared to “other” webpages when assessed using the PEMAT. There were no other significant differences between type of organisation or location.

Conclusion: For people to be able to make informed health decisions they need to be presented with information that they can understand as well as suitable information that is of a good quality. The findings from this research indicate that the readability of online

information about SSNHL is not appropriate for a large portion of the population. The suitability and quality is also below what is required for the general population. Therefore, people searching for online information relating to SSNHL may have difficulty reading and interpreting the webpages relating to SSNHL.

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List of abbreviations

ANOVA	Analysis of variance
ccTLD	Country-coded Top-Level Domains
CIA	Central intelligence agency
dB	Decibel
DHB	District health board
F-K	Flesch-Kincaid
FOG	Gunning Fog Index
FRE	Flesch Reading Ease
HL	Hearing loss
HON	Health on the net
ICC	Intraclass correlation coefficient
MRI	Magnetic resonance imaging
PEMAT	Patient education materials assessment tool
PL	Plain language
RGL	Reading grade level
SD	Standard deviation
SMOG	Simple measure of Gobbledygook
SSNHL	Sudden sensorineural hearing loss
URL	Uniform Resource Locator
WHO	World Health Organisation

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Chapter 1: Literature Review

1.1 Hearing loss

Worldwide, it is estimated that 466 million people currently experience a disabling hearing loss (World Health Organisation, 2019). Hearing loss is most prevalent in adults, with approximately 50% of adults who are in their 7th decade of life, and 80% of adults over age 85 experiencing a hearing loss. It is the fourth most common cause of disability worldwide according to the Global Burden of disease study (Cunningham & Tucci, 2017). Hearing loss can range in the degree of severity and perceived handicap.

There are many causes of hearing loss, with the most common cause in adults related to aging, known as presbycusis (Gates & Mills, 2005). Over 40% of adults aged of 65 having a hearing loss which affects their ability to communicate (Gates & Mills, 2005). Hearing loss can be congenital or acquired, and may be caused by genetic defects, diseases, viruses, trauma, or noise exposure (Ropper, Cunningham, & Tucci, 2017). Hearing loss which is acquired is most commonly gradual, although in some cases onset can be sudden (Chau, Lin, Atashband, Irvine, & Westerberg, 2010).

Hearing loss can be conductive, sensorineural or mixed (a combination of the two) (Eggermont, 2017). A conductive hearing loss is due to a blockage of the transmission of sound to the inner ear, whereas a sensorineural hearing loss is usually permanent and involves dysfunction of the inner ear or the peripheral or central auditory nerve system (Eggermont, 2017).

No matter the cause or type of hearing loss, hearing loss can negatively impact individuals and the greater society. It has been shown that individuals with untreated hearing loss tend to struggle more with things such as loneliness, depression and isolation (Levertson,

2019; Mener, Betz, Genther, Chen, & Lin, 2013) while at a societal level people are less likely to get promotions or gain higher education (Garramiola-Bilbao & Rodríguez-Álvarez, 2016).

1.2 Sudden sensorineural hearing loss

Sudden sensorineural hearing loss (SSNHL) is defined as a sensorineural loss of 30 dB HL or greater over 3 or more frequencies within a 72-hour period (Kuhn, Heman-Ackah, Shaikh, & Roehm, 2011). SSNHL can occur in any population with no difference in occurrence between males and females, however the incidence increases with age (Alexander & Harris, 2013) as people in their 5th and 6th decades of life have a higher prevalence compared with other age groups. Nearly all cases of SSNHL are unilateral, however it is also possible to have bilateral SSNHL which make up less than 5% of cases (Schreiber, Agrup, Haskard, & Luxon, 2010). Individuals who have had a SSNHL may also have a negative change in their quality of life post SSNHL occurrence. It has also been shown that individuals who have had a SSNHL have poorer quality of life outcomes 8 years on than those who have had a SSNHL which has largely recovered (Härkönen, Kivekäs, Rautiainen, Kotti, & Vasama, 2017).

In some patients (32-65%) SSNHL can resolve itself within 15 days (Lai, Zhao, Jalal, & Zheng, 2017). The biggest concern regarding SSNHL is that treatment, which is usually a dose of corticosteroids, if done within an appropriate time frame may improve hearing levels (Chau et al., 2010). The quicker the steroids are administered the greater the chance of any hearing recovery, however the general consensus is that people will be offered treatment if they present themselves to a health care professional with two weeks of initial onset (George & Pradhan, 2009). Therefore, sudden hearing loss needs to be treated as an emergency. However, people may not be aware of the seriousness of their hearing loss and simply put it down to a “blocked” ear.

SSNHL loss is relatively uncommon but not rare, with around 27 cases per 100,000 people annually (Alexander & Harris, 2013), although this figure may be higher due to unreported cases. Common causes include but are not limited to; viral, infection, immune related or most commonly idiopathic. With just 1% of cases attributed to retro cochlear disorders, 10-15% due to identifiable causes including autoimmune disorders, Meniere's disease, or trauma that leaves at least 70% of cases attributed to unknown causes (Alexander & Harris, 2013; Rauch, 2008). Management options of SSNHL are similar to that of other types SNHL including counselling and amplification.

1.2.1 Diagnosis

As mentioned previously, SSNHL is defined as losing hearing by more than 30 decibel (dB) hearing loss (HL) in one or both ears across 3 frequencies within 72 hours. It is worth noting that people may also experience other symptoms depending on the cause of the hearing loss including aural fullness and or dizziness (Schreiber et al., 2010). Some people also hear a loud "pop", before losing hearing in that ear (Vijayendra, Buggaveeti, Parikh, & Sangitha, 2012). Therefore, the typical diagnosis involves a diagnostic audiological assessment to determine the degree of hearing loss and whether the hearing loss is SNHL, conductive or mixed. A mixed hearing loss does not exclude SSNHL, however the SNHL portion of the hearing loss must still be greater than 30 dB HL for it to be categorised as a SSNHL. This criterion may make it hard to diagnose if a person has not had a hearing test before, or if they come in days after they first noticed the drop in their hearing. However, some assumptions can be made by the clinician (Ear nose and throat doctor or general practitioner in New Zealand) based on the patient's description of events and previous hearing.

While diagnosing the presence of SSNHL may not be too complex determining the cause of the SSNHL may not be possible. It is also important to note that it is recommended

to refer the patient for an MRI to rule out that an acoustic neuroma may have caused the sudden hearing loss (Fishman & Cullen, 2018).

1.2.2 Pathophysiology

As the majority of cases of SSNHL are idiopathic which means that the cause is unknown (R. J. Lin, Krall, Westerberg, Chadha, & Chau, 2012). However, there are some theories around what causes some of the idiopathic cases. There are multiple case studies (Choi & Ko, 2019; Huy & Sauvaget, 2005; Jeong, Choi, Shin, & Kim, 2016) within the literature of rare causes for a patients SSNHL, including neural related or tumours, however these are not conclusive for the majority of idiopathic SSNHL cases. The two more common theories suggest that either chronic inflammation (Chen et al., 2018), or micro-vascular issues could be a cause of idiopathic SSNHL. Two other theories suggest that viral cochleitis (Berrocal, Ramirez-Camacho, Portero, & Vargas, 2000; Merchant, Durand, & Adams, 2008) or membrane rupture within the cochlear (Gussen, 1983) could cause idiopathic SSNHL.

Inflammation is one of the main theories of what could cause idiopathic SSNHL. Corticosteroids are widely used to treat idiopathic SSNHL and this supports this theory (Ikinciogullari et al., 2014). There is some evidence that patients who are diagnosed with a SSNHL also have higher levels of inflammation markers, including monocytes, in their blood at the time of diagnosis compared to normal levels (Ikinciogullari et al., 2014; Yoon, Kim, Kim, Lee, & Jang, 2019). Masuda et al. (2012) found that in patients with a SSNHL who had higher than normal levels of neutrophils they were more likely to have a severe hearing loss and a poorer prognosis. While different studies have found links involving SSNHL and inflammation markers, none of them provide enough specificity to use as a specific marker to predict SSNHL (Chau et al., 2010). It is proposed that inflammation could cause SSNHL due to immunocompetent cells (cells which mount an immune response) passing through the

blood-labyrinth barrier into the cochlea and inducing an auto-immune response within the cochlea which can negatively affect the organ of corti, spiral ganglion and stria vascularis (García-Berrocal et al., 2005).

Authors of one study found that 29% of patients seen with SSNHL had a concurrent microvascular disease such as diabetes or hypertension. While this is a correlation there is only some evidence to suggest causation. However, for patients with these types of concurrent diseases the prognosis for hearing recovery is lesser than other patients without the diseases (Hirano et al., 1999). As the cochlear requires a high supply due to high metabolic demands it is susceptible to changes in blood supply (Kim, Sim, Kim, & Choi, 2018), some studies (Keller, Wu, Kang, & Lin, 2012; C. Lin, Lin, Lin, Weng, & Lee, 2013) have suggested that there is an association between SSNHL and myocardial infarction as a potential indicator of future vascular diseases. However, a large longitudinal study found that when individuals (4467 patients with SSNHL) were matched against controls based on factors including age, sex and health rather than just demographics, there was no correlation between SSNHL and myocardial infarction (Kim et al., 2018). There is also no histological evidence to suggest that vascular impairment causes SSNHL, and a review did not find any conclusive evidence to prove that SSNHL is caused by this (Schreiber et al., 2010).

In most cases it is not possible to determine the cause of the hearing loss until post-mortem. Merchant, Adams, and Nadol (2005) performed histology on 17 different temporal bones of people who had experienced SSNHL at some point in their lives. Their findings showed that the most common histological findings were the loss of either inner or outer hair cells (13 ears). From this the authors concluded that the most likely cause was the activation of stress pathways within the cochlear causing hair cell death rather than viral causes. It has also been found that administering anti-viral medication to patients with SSNHL was not beneficial in

terms of remission rates in idiopathic cases and therefore it may be less active than once suspected (Övet et al., 2015).

1.2.3 Treatment and effectiveness

The most common treatment dispensed for idiopathic SSNHL are oral or intra-tympanic steroids. If a cause of the SSHNL is known, then treatment will be administered appropriately. However, most cases of SSNHL are idiopathic (Chau et al., 2010). In New Zealand there will be different protocols depending which district health board (DHB) you are getting treated at. The ideal time for a patient to receive treatment is within 48 hours, although a patient will likely still be given treatment if they are seen within two weeks (George & Pradhan, 2009), however the likelihood of regaining hearing decreases as time lapses (Swan, Mescher, Sewell, Tao, & Borenstein, 2008). Some patients experience a rapid recovery in hearing after the initial dose of corticosteroids, while others do not fully recover or do not recover at all (Rauch, 2008). While this is the ideal time frame to be seen, it has been reported that the mean timeframe of patients receiving treatment was 28 days post SSNHL onset (Swan et al., 2008), this could be due to a variety of factors.

There is a considerable amount of research which has looked at the effectiveness of steroids given as a treatment for SSNHL, as well as whether it is best that they are given orally or trans-tympanal. Traditionally steroids were administered systemically (Han, Yin, Du, & Sun, 2017) with the most common prescribed being prednisone. Many authors have since looked at the effectiveness of steroids administered systemically vs trans-tympanic. There are benefits and risks to both methods, with the prognosis of both methods similar as found in two meta-analyses (Lai et al., 2017; Liebau, Pogorzelski, Salt, & Plontke, 2018). However, as to be expected, studies at an individual level have contradictory findings. This is likely to be due to differences including but not limited to the types of steroids given, time of

treatment post HL, dosage administered and severity of the HL. Gümüşsoy, Arslan, and Ibrahim (2013) et al. found that patients in the intra-tympanic treated group had an average hearing loss improvement from 68 dB to 34 dB while the systemically treated group had an improvement in hearing from 67 dB to 44 dB, which found that overall there were better results using intra-tympanic treatment.

Most studies (Lai et al., 2017) have used the threshold of an improvement of hearing by at least 10 dB as an improvement. There can be risks of administering steroids trans-tympanically and common complications include otalgia and vertigo, although these complications tend to be short in duration. Side effects which are associated with systemic steroid administration include hypertension, weight gain, mood changes, hyperglycaemia and increased thirst (Lai et al., 2017). As a higher dosage of steroids is required when administered systemically and this can lead to more side effects compared with intra-tympanic administration. This is due to the level required in the blood, as well as the presence of the blood-cochlea barrier which prevents small molecule passing through due to tight junctions (Parnes, Sun, & Freeman, 1999) (Swan et al., 2008). Therefore molecules (such as steroids) entering the perilymph from the systemic circulation must be either dissolve into the capillary epithelia or be actively transported across and thus a higher concentration is required compared with intra-tympanic administration.

There is evidence to suggest that there may be benefits to a combined treatment approach of administering the steroids both trans-tympanically and systemically. Han et al. (2017) performed a large meta-analysis of RCTs and concluded that there were better patient outcomes when a combined approach was used. It was hypothesised that the steroids do not reach circulation efficiently when administered trans-tympanically which may result in less than ideal outcomes. A survey of ear nose and throat doctors in Germany and Austria found that 49% of otolaryngologists use intratympanic administration of steroids in response to

SSNHL, with 20.6% using it in conjunction with oral administration (Sutton et al., 2018).

This suggests that there is a large variability of protocols.

While the use of steroids to treat SSNHL is widely supported, a meta-analysis based on the use of placebos or steroids to salvage hearing found there to be no statistically significant benefit to using steroids over a placebo (Crane, Camilon, Nguyen, & Meyer, 2015). This was also observed by Huy and Sauvaget (2005) who found no difference in treatment outcomes in patients who received treatment within 24 hours of onset compared to receiving treatment within one week of onset. However, Parnes et al. (1999) found that in animal studies there is a higher penetration rate of drugs to the cochlear when administered topically compared to systemically. It appears that further research is required regarding the type of administration and efficacy of the steroids. While there are some uncertainties around these issues, there is still sufficient evidence to suggest that if a patient is administered steroids for an unknown cause of SSNHL then it is likely that the benefits will outweigh the side effects of the treatment option.

A more recent treatment method includes using steroids in conjunction with hyperbaric oxygen therapy. One metanalysis of 14 random controlled trials (RTCs) showed overall a greater improvement in hearing compared with steroids alone (Han et al., 2017) , however the authors of another metanalysis (Bennett, Kertesz, Perleth, Yeung, & Lehm, 2012) cautioned that these conclusions should be looked at carefully due to small sample sizes and variations in methods. Current evidence suggests that due to the limited evidence and high cost of the therapy that hyperbaric oxygen therapy should not be routinely used to manage SSNHL (Lawrence & Thevasagayam, 2015). However, with further research this could be a future treatment option, specifically for idiopathic SSNHL.

A person who has previously experienced a SSNHL is more likely to experience another SSNHL compared with someone who has never experienced a SSNHL (Park, Kim,

Choi, & Hong, 2013). However, reoccurrence is still relatively uncommon. In one longitudinal study which followed 1798 people who had experienced SSNHL, only 14 had previously been diagnosed with SSNHL and just two of 88 (2.3%) patients who returned to the hospital more than 10 years later had experienced another case of SSNHL (Furuhashi, Matsuda, Asahi, & Nakashima, 2002). In comparison, a person who has never experienced a SSNHL the likelihood is approximately 0.03% (Alexander & Harris, 2013). While a secondary bout of SSNHL is relatively uncommon it is more common that the initial hearing loss may continue to progress. Furuhashi et al. (2002) found that in 25/88 patients (28%) their hearing had progressed from the initial hearing loss – all of these patients had initially received treatment at the same hospital.

Recovery or degree of recovery is dependent on many factors. This includes not only treatment type and time, cause of SSNHL but also the degree of hearing loss that has occurred. Attanasio et al. (2018) created a model based on outcomes of people who had a SSNHL and were treated with intra-tympanic steroids. From this model once age and degree of hearing loss were accounted for it was predicted that each day of treatment delay results in the probability of success (regaining a significant amount of hearing) decreasing by 3%.

A person who has developed a severe SSNHL is less likely to recover compared with a person who has developed a mild or moderate SSNHL (Li & Jiang, 2016). This is likely due to a greater level of damage occurring within the cochlear or auditory nerve (Li & Jiang, 2016).

Some people may choose not to get treatment, or treatment may not be effective. In these cases, it is likely that the person will need to manage their new hearing loss. Once the hearing loss has settled patients who have had a SSNHL will be managed in a similar way to other patients who have a similar audiometric hearing loss, however these patients may

require more counselling as it will be an acute change rather than a gradual hearing loss such as the more common presbycusis.

SSNHL is usually asymmetrical (Chau et al., 2010), and therefore some people will choose not to get amplification. As patients are most commonly in their 4th decade of life (Zhang et al., 2015), they may already be developing age related hearing loss. The sudden loss in one ear will likely make it difficult for the person to hear, especially in group settings and in background noise (Wazen, Ghossaini, Spitzer, & Kuller, 2005). This may mean the person may want some form of amplification. SSNHL can be managed through amplification by traditional air conduction hearing aids, bone anchored devices (Härkönen et al., 2017) or even implanting cochlear implants if the patient has a severe or profound loss (Blasco & Redleaf, 2014).

Amplification is not the only management option, although often it is the most effective depending on the degree of hearing loss (Härkönen et al., 2017). Other management tools such as counselling and communication strategies should also be used in conjunction with amplification, if the patient chooses to use amplification devices as this results in better patient outcomes for people who have had a SSNHL (Carlsson, Hall, Lind, & Danermark, 2011). If the patient chooses not to use amplification then the hearing care professional can go through other strategies such as lip reading, asking people to look at them while speaking and talking in quieter areas of a busy place.

As this health condition has the potential to be improved or reversed if treatment is sought quickly it is important that patients are able to find and understand information about SSHNL. However, nearly half of American adults are unable to understand and navigate the health system to make appropriate well informed health related decisions (Hewitt et al., 2014). Therefore, people who are unable to make informed health decisions, especially

regarding treatment options, from health information sources are going to be disadvantaged if the material is not at a suitable level for them.

1.3 Health literacy

1.3.1 Definition of Health Literacy

The World Health Organisation defines health literacy as the ability of a person to gain access too, understand and use health material in a way which promotes good health in individuals (World Health Organisation, 2016). There is an association between people who have a low level of health literacy and having poorer health outcomes compared with people who have an adequate level of health literacy. Not only does having a low level of health literacy affect individual patient outcomes, but it can result in higher costs to the health care system or the individual and the economy (Eichler, Wieser, & Brügger, 2009; Haun et al., 2015; Howard, Gazmararian, & Parker, 2005). It has been estimated that the effects of low health literacy result in an additional 3-5% increase to the cost of health care per year (Eichler et al., 2009). This is due to an increase in treatment costs, care of patients who are ill, as well as loss of productivity due to inability to work. While it is known that the cost of low health literacy is high, more research is warranted as there are no studies which specifically look at low health literacy relating to hearing health care, nor are there any studies which are New Zealand specific in terms of cost to the health system.

1.3.2 Prevalence of Low Health Literacy

A person can still have an adequate level of literacy, yet a poor level of health literacy. While someone may be literate in ordinary situations, they may not be able to understand those same words in a health context.

It is estimated that there is 80 Million Americans with low health literacy, (Eichler et al., 2009) with nearly half of adults in Europe have a low level of health literacy, to the degree which it would impair them while making health related decisions (Kickbusch, Pelikan, Apfel, & Tsouros, 2013). Rates of low health literacy tend to be more prevalent in those who are poorer, elderly, have less than high school level education and those who belong to minority groups (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). Some minority groups including Māori and Pasifika, who in general tend to have poorer health outcomes compared to the general population, also have lower levels of health literacy which could partly attribute to this (Ministry of Health | Manatū Hauora, 2010). Māori men in particular are more likely to have a low level of health literacy with four out of five having an insufficient level of health literacy (Ministry of Health | Manatū Hauora, 2010). As this population is already vulnerable, it is important that health information is at a level that can be easily comprehended, to improve patient outcomes.

1.3.3 Improving Low Health Literacy

Health literacy is important as it enables individuals to make informed decisions, especially around treatment options, while also decreasing the other negative effects of health literacy. This involves understanding the risks and benefits of treatment option, including opting for no treatment.

One way to improve low health literacy rates is to target the issue directly, through education. This is more a long term strategy however. Health literacy could be a target through the education system during a person's schooling life. Developed countries are already using education to try and reduce the negative effects of common health issues through media campaigns (Nutbeam, 2000) such as promoting vaccinations and the importance of preventative techniques such as smear tests to detect cervical cancer.

Another possible way to mitigate the effects of low health literacy is to improve the delivery of information to patients. This can be done by improving the quality of delivery in person to patients as well as material which patients are either given or can access elsewhere, including online. This could include eliminating jargon, asking the patient to repeat the information and using plain language.

Kountz (2009) suggested that every time a patient comes in that they should complete a quick health literacy questionnaire so that the information given to the patient could then be appropriately altered. However, this could make patients feel uncomfortable and would not tackle the issue of when patients independently seek out health information.

1.4 Health information

1.4.1 Sources of health information

There are many different sources of health information, from a variety of different mediums. These mediums include active communication which includes; interpersonal communication, printed materials and the internet – as well as passive methods including; television and radio (Dutta-Bergman, 2004). The most trusted source of health information from a personal source is a person's family doctor (88% of participants), while the most trusted form of information from a media source is the internet (30% of participants) (Williams, Ames, & Lawson, 2019). The type of primary source of health information a person is more likely to use can be

associated with their education, age and drive to search for health related information (Geana, Kimminau, & Greiner, 2011; Simmons, Wu, Yang, Bush, & Crofford, 2015). However, it must also be noted that in one study (Simmons et al., 2015) 20% of participants did not know where to seek out health information relating to their health condition. It has been found that individuals who are more “health driven” are more likely to seek out information by using active communication medias such as seeing their doctor or searching online, while less “health driven” individuals are more likely to get their information from passive sources such as the television or radio (Dutta-Bergman, 2004). As the preferred source of health information is so variable, companies and organizations should aim to put out their content through a variety of mediums.

1.4.2 Online health information

The use of the internet to access health information has been steadily increasing (Jacobs, Amuta, & Jeon, 2017). It has been found that approximately 80% of Australians access the internet to search for health information (Cheng & Dunn, 2015), with similar numbers in the USA and Europe (Sillence, Briggs, Harris, & Fishwick, 2007). It has also been shown that most people will seek health information from the internet as their initial source of information compared with traditional resources such as a health professional or person they may know (Jacobs et al., 2017). People with hearing impairments also use the internet to find information about hearing related health issues, and it has been found that they use the internet in a similar way to people with other health conditions (Peddie & Kelly-Campbell, 2017). It has also been found that females are more likely to seek online help relating to their hearing compared with males (Ratanjee-Vanmali, Swanepoel, & Laplante-Lévesque, 2019).

This could disadvantage males if they are not seeking hearing health information from other sources.

As more people gain access to the internet and people become more accustomed to the internet it is likely that there will be an increase of people who use the internet to search for health related information. (Bujnowska-Fedak, 2015; Bundorf, Wagner, Singer, & Baker, 2006). There is no current literature to date which has examined the use of the internet by people who have SSNHL, nor the quality and suitability of online health information relating to SSNHL.

1.4.3 Benefits of online health information

Using the internet to access health information can allow the patient to be better informed by providing the patient with information they may not otherwise have access to. The internet enables people who live remotely who may not be able to make it in to seek professional health advice the ability to access health related information online (Bundorf et al., 2006). Online health information is also often free, or low cost and therefore people who are already disadvantaged due to socioeconomics have the ability to access health information if they could not otherwise afford it.

1.4.4 Disadvantages of online health information

While using the internet to access health information has benefits there are also factors which make can make the internet less than ideal source of information in regard to health information. The recommended reading grade level (RGL) for health-related material is at grade 6 or below (Weiss, 2003), while most online health information has an RGL far greater

than this (Cheng & Dunn, 2015). A recent study found that just 0.4% of health related webpages had an RGL of less than 8 (Cheng & Dunn, 2015). This means that a lot of adults will not be able to fully comprehend the material they are reading.

People who use the internet to seek out health information tend to be more health anxious and hence why they are seeking out more information. However, using the internet to seek out health information tends to have a more negative than positive effect on health anxious individuals (Baumgartner & Hartmann, 2011). This is likely as people who are anxious are also more likely to search for online health information (te Poel, Baumgartner, Hartmann, & Tanis, 2016) as well as being more likely to misinterpret information and potentially catastrophise their symptoms (Baumgartner & Hartmann, 2011).

While some people trust the quality of the health information they found online, there is a large amount of information online which is of poor quality. Even though there is potential for online health information to be accessed and utilised by many demographics, it has been found that the people who most benefit from using the internet to access health information are younger, educated more internet skilled people (Jacobs et al., 2017). This is in contrast to people who are more likely to develop a SSNHL in their 4th decade of life (Zhang et al., 2015). People with a low health literacy often also struggle to evaluate the quality of online health information, which can lead to poor decision making around their health and treatment options (Diviani, van den Putte, Giani, & van Weert, 2015).

1.5 Readability

1.5.1 Defining Readability

Readability can be defined as the ability to make complete sense of a written (or audio) material (McInnes & Haglund, 2011). The readability of a material can be measured using a variety of formulae to calculate the reading grade level (RGL). A lower RGL is associated with an improved ease of reading and understanding, while a high RGL is harder for people to read and understand (McInnes & Haglund, 2011).

1.5.2 Readability of online Health Information

High RGLs can result in some people having poorer health related outcomes, especially if they are not health literate. It is recommended that the RGL of health material be at or below 6th grade level (Weiss, 2003) for the majority of the population to be able to comprehend the material. However, most online webpages relating to health sources have a higher RGL than recommended with an average RGL of between 12.30 (based on an analysis of online information of 22 health conditions) (McInnes & Haglund, 2011). Online hearing related information also tends to be at a higher than recommended RGL, with the mean RGL ranging between 9 to 14 (Laplane-Lévesque & Thorén, 2015).

1.5.3 Readability Formulas

There are many commonly used formulae to calculate the RGL of a piece of health material including the Flesch-Kincaid (F-K), Flesch Reading Ease (FRE), the simple measure of gobbledygook (SMOG), and the Gunning's fog readability index (FOG). Each formula is calculated differently and takes different factors into account. For example, the F-K tends to

score material 2-3 grades lower than the SMOG, (Grabeel, Russomanno, Oelschlegel, Tester, & Heidel, 2018) while the F-K and FRE tend to be more similar (Jindal & MacDermid, 2017; Wang, Miller, Schmitt, & Wen, 2013). Therefore, it is recommended to use more than one formula and average the scores (Wang et al., 2013). All of the above readability formulas can be calculated either manually or electronically.

Different factors are used to calculate the RGL, depending on the formulae used. These include but are not limited to; number of words per sentence, average number of syllable per word and number of words with 3 or more syllables (Wang et al., 2013). Below are the following formulae and the factors they use to calculate the average RGL for a piece of text.

FOG

The FOG was developed by Gunning in 1952. The expected comprehension is 90% as based on the McCall-Crabbs (Wang et al., 2013). Below is the formula for FOG as adapted from Gunning (1952).

$$Grade = 0.4 \left(\frac{words}{sentences} \right) + 100 \left(\frac{complex\ words}{words} \right)$$

F-K

The F-K was originally modified from the FRE. The expected comprehension is 30% as based on a Cloze test (Wang et al., 2013). This equates to 75% comprehension based on the McCall-Crabbs (Wang et al., 2013). Below is the formula for the F-K.

$$Grade = .39 + \left(\frac{Total\ Words}{Total\ Sentences} \right) + 11.8 \frac{Total\ Syllables}{Total\ words} - 15.9$$

SMOG

The SMOG has an expected comprehension of 100% based on the McCall-Crabbs (Wang et al., 2013). This is higher than the two formulae above so estimates a higher RGL. The SMOG is commonly used for assessing the RGL of health information. The SMOG formula is below.

$$Grade = 1.0430 \sqrt{\text{number of polysyllables} \times \frac{30}{\text{number of syllables}}} + 3.1291$$

1.6 Suitability and Quality

1.6.1 Defining Suitability

While the readability of a piece of material is an important factor when considering patient education material there are some limiting factors which mean it does not provide a suitable assessment of a materials quality or suitability. Readability formulas do not take into account other factors such as the design, layout and content of a material which are equally as important when determining the suitability and quality of a health-related material. Suitability of a material can be defined by its appropriateness for the audience, the content of the material as well as the general ease of reading the material often including layout, typography and grammar (Shieh & Hosei, 2008). Most suitability tools including the PEMAT (Shoemaker, Wolf, & Brach, 2014) and DISCERN assume the reader is a lay member of the general public. While using tools which measure the suitability of a material in conjunction with readability formulas is an improvement on assessing materials using RGL formulas

alone there are still some limitations. For example, there are no validated tools can assess the motivations, subject knowledge or education levels of a reader.

1.6.2 Quality & Suitability

There are a multitude of tools which can be used to measure the suitability of a piece of material. It is important that where practical more than one tool is used when measuring suitability as each tool measures suitability in a different way. If it is only practical to use one tool then using a validated tool such as the PEMAT or DISCERN would be best (Bonner, Patel, Fajardo, Zhuang, & Trevena, 2019).

1.6.2.1 PEMAT

The PEMAT was developed initially to overcome the limitations of readability formulas (Vishnevetsky, Walters, & Tan, 2018), when assessing patient education materials particularly relating to health education materials. The PEMAT has been assessed in a study which found that it had good inter-reliability between raters (Vishnevetsky et al., 2018). These same authors did note that the study participants were mostly health professionals which could bias the ratings compared with how a lay person may interpret the health information. It is also a validated tool which can be used to assess both written and audio/visual materials, and is used by researchers to measure the understandability and actionability of health related materials (Shoemaker et al., 2014).

1.6.2.2 DISCERN

The DISCERN is particularly useful to evaluate materials which focus on treatment options, and this is emphasised in the questionnaire. The authors of the DISCERN describe the DISCERN as a tool which can be used to assess “the quality of written information on treatment choices for a health problem” (DISCERN, 2019). Therefore, webpages which contain no treatment options, or one treatment option will likely score poorly on the DISCERN. However, this is not a limitation as a health related patient education material should contain some information about treatment options, so the user can make an informed decision.

1.6.2.3 Plain Language Checklist

The plain language checklist was formed as a new tool for the purpose of the research, performed by the research team. This was done by combining aspects of the checklist for plain language on the web provided by Plain language action and information network (Centre for health literacy, 2020) and the quick checklist for plain language on the web (Plain Language Action and Information Network, 2020), so is therefore not a validated tool. The plain language checklist objectively analyses the ease of reading the webpage as a whole. The plain language checklists examine the type of language used, the grammar as well as the layout and formatting of the webpage.

1.6.2.4 HONcode

The HONcode was created by the HON foundation as an easy way for people to identify the quality and source of human health information (Boyer, Selby, Scherrer, & Appel, 1998). The HONcode is a code of conduct which authors must adhere to, so that they can gain HONcode

certification. The HONcode does not rate or rank the quality or content of the health information. To gain HONcode certification there are a set of basic rules the authors of the health information must follow. Some criteria that are required on the health information to gain HONcode certification include, transparency, financial disclosure, qualifications of the author(s), and attribution of sources (HON). Users who would like to check if a website is HONcode certified can easily put the website URL into the HONcode website to see if it is certified. There are over 7000 accredited sites, however most of these (over 80%) are US based.

1.7 Improving health information

It is vital that health information is improved so that patients can make informed decisions around treatment options. It is also important to achieve better health outcomes. Education is a key factor to improve health literacy, however this is not an instant fix, nor would it be necessarily possible in some nations. Therefore, the best possible way to improve patient outcomes is to improve the health information which patients access or are given.

While most hearing care providers are aware that patients who have a low level of health literacy were at a disadvantage, many are not aware of the recommended RGL for health related material or the readability of clinic forms (Atcherson, Zraick, & Hadden, 2013). Educating health care providers on the benefits of better health information for patients would result in better health outcomes for patients.

Improving health information can be done by improving the readability of the material, the content, design as well as using plain language. It is important that the content of the material is correct. It has been found that improving the quality of the health information results in better patient outcomes. This is also true for hearing related health information. A revised version of a hearing aid manual to current health literacy

recommendations resulted in both less time required to read the manual as well as an improvement of ability to do the tasks (Caposecco, Hickson, Meyer, & Khan, 2016).

Verification such as the HONcode can help patients be assured that what they are reading is a resource which has met a set of standards and therefore they can be assured that the information they are reading will be correct and be a good resource they can base health care decisions on. Unfortunately, the HONcode is not very well publicised, so people who are already disadvantaged due to various factors including poor education may not be aware of its existence.

1.8 Study Rationale

People are increasingly using the internet to search for health information, this includes people with hearing loss. SSNHL is an acute type of disorder, which can persist to be a chronic hearing loss. The internet can be a helpful source of hearing related health information; however, it can also be a confusing source for many individuals. Online health information tends to be at an RGL higher than the recommended for the general population to be able to comprehend.

Evidence suggests that people who seek treatment within 48 hours, of corticosteroids either systemically or via intra-tympanic administration are more likely to regain some hearing by a significant amount. While the condition is not considered life threatening if it is not associated with other medical conditions, it should justifiably be treated as a medical emergency due to the potential of improving the patient's quality of life.

Therefore, if online health material is not at a suitable RGL for the general population or contains poor information about the condition and treatment options relating to the condition then people may not be aware how urgently they should be seeking medical care. To date, no research has been undertaken to examine the suitability and quality of online

health information relating to SSNHL. If the content is not of an acceptable level of suitability and quality then this research can be used as a baseline to guide further research on improving the standard of online health information relating to SSNHL.

1.9 Research Aims and Hypotheses

1.9.1 Research Questions

The aim of this study was to report on the readability and suitability of online SSNHL health information available in English. The study aimed to investigate the following research questions:

- 1) Is there is an even distribution of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification?
- 2) Are there are any significant differences in mean RGL of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification?
- 3) Are there are any significant differences in mean DISCERN scores of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification.
- 4) There are no significant differences in mean PEMAT scores of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification.
- 5) Are there any significant differences in mean Plain Language scores of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification.
- 6) Are there any no significant correlations between Mean RGL and (a) DISCERN scores, (b) PEMAT scores, (c) Plain Language Scores.

Based on the research questions 6 null hypotheses exist.

1.9.2 Null Hypotheses

- 1) There is an even distribution of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification.
- 2) There are no significant differences in mean RGL of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification.
- 3) There are no significant differences in mean DISCERN scores of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification.
- 4) There are no significant differences in mean PEMAT scores of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification.
- 5) There are no significant differences in mean Plain Language scores of webpages on SSNHL based on: (a) type of organisation, (c) locality of organisation, (c) HonCode certification.
- 6) There are no significant correlations between Mean RGL and (a) DISCERN scores, (b) PEMAT scores, (c) Plain Language Scores.

Chapter 2: Method

2.1 Overview

The purpose of this study was to assess the readability and suitability of online health information relating to sudden sensory neural loss (SSNHL). Ethics were obtained from the University of Canterbury Human Ethics Committee. This chapter covers the inclusion of participants, the selection of search terms and the assessment of the webpages. The readability of the webpages was assessed using the F-K, FOG and SMOG. The suitability of the webpages was assessed using PEMAT and DISCERN. The plain language was assessed using a modified version of the quick checklist for plain language and the checklist for plain language on the web.

2.2 Population of interest and survey

The population of interest was members of the general public who could speak fluent English. Participants needed to be over 18 years of age. There were no exclusion criteria. A short online survey was distributed to participants via Facebook and email. In the survey the participants were asked demographic questions as well as “What Search terms would you put into Google if you or someone you know suddenly got a hearing loss? Please list as many terms as you can think of”. The survey was made available until data saturation was achieved. Data saturation was defined as two consecutive responses which gave no new relevant search term information. A minimum of ten responses was also required.

2.3 Identification of Search terms

The search terms used to find the online material were derived from the survey results. The search terms which participants gave were entered into Google trends

(<https://trends.google.com/trends/?geo=worldwide>). Google trends analyses search terms in different regions.

The search terms were entered into Google trends, with “worldwide”, “last 12 months” and “all categories” selected. From the results, the trends were analysed, and the most used search terms were used to conduct the searches to find the online health information. The top 10 search terms which were derived from google trends, and used to conduct the searches were as follows:

Hearing loss

Sudden hearing loss

Sudden sensorineural hearing loss

I can't hear

Hearing Doctor

Deafness

Ear doctor

Reasons for hearing loss

Temporary hearing loss

2.4 Search Location

The search terms were put into the Google search engine in a total of 21 country domains.

The domains were selected by first identifying all country coded-top level domains (ccTLDs) where English is an official language and there are over two million internet users. The region, countries, total internet users and internet penetration rate can be seen below in Table

1. This process was done by retrieving the list of regions selectable which can be accessed in Google settings under “Advanced Search”. These regions were then put into an Excel spreadsheet.

Next, countries with English as an official language were retrieved from the CIA World Factbook (Central Intelligence Agency, 2007). There were 66 countries which had English as an official language, which resulted in a total of 1,420,288,344 internet users from these countries. Countries which had less than two million internet users were excluded from the study (Internet World Stats, 2019). This resulted in using the Google search engine from a total of 21 countries with 1,377,149,400 internet users, which encompasses 97% of English

Table 1: Countries included in internet search with English as an official language and/or used for commerce and at least two million internet users

Country	Region	Internet Penetration Rate	Population of Internet Users
Kenya	Africa	83.0%	43,329,434
South Africa	Africa	53.7%	31,185,634
Tanzania	Africa	37.8%	23,000,000
Uganda	Africa	41.6%	19,000,000
Zimbabwe	Africa	39.3%	6,796,314
Cameroon	Africa	24.2%	6,128,422
United States	Americas	89.2%	292,892,868
Canada	Americas	92.7%	34,558,385
Puerto Rico	Americas	83.3%	3,047,311
United Kingdom	Europe	94.2%	63,061,419
Ireland	Europe	91.9%	4,453,436
India	South-East Asia	40.9%	560,000,000
Indonesia	South-East Asia	53.2%	143,260,000
Philippines	South-East Asia	62.0%	67,000,000
Malaysia	South-East Asia	80.1%	26,009,000
Australia	Western Pacific	87.8%	21,743,803
Hong Kong	Western Pacific	89.4%	6,698,252
Singapore	Western Pacific	84.5%	4,955,614
New Zealand	Western Pacific	88.1%	4,184,520
Total in study			1,361,304,412
% in study			97%

2.5 Search Inclusion and Exclusion criteria

Webpages were included in the study provided that they: (1) were written in English, (2) contained information related to sudden hearing loss and (3) were accessible to the general public. Webpages were excluded from the study if they: (1) had a pay wall, (2) were less than 100 words long, (3) were a Google-identified advertisement and (4) were a directory.

2.6 Search Procedure

The search terms which were derived from Google trends were placed into the Google search engine of each Google domain which was being included in the study. The search took place on the 27th June 2019 using a Google chrome browser on a computer which was not associated with previous hearing related search terms. The ccTLD was selected for each country through Google settings. From there the search terms were entered separately into the Google search of each domain. Following that, the webpages from the first page which met the search inclusion/exclusion criteria were selected. If there were not at least 10 webpages on the first page from the search, then webpages from the following pages would be examined to see if they met the inclusion/exclusion criterion until there were at least 10 webpages which had been looked at. Any duplicates were removed once all the searches were complete. A total of 41 webpages were used in the analysis.

The Uniform Resource Locator (URL) of each website was recorded in an excel spreadsheet. Alongside this the country of origin (as determined from the ccTLD or “about us” section), presence or absence of HON-code verification and type of organisation (“Commercial” or “other”) were also recorded. If the country of origin was not easily identifiable further online research was carried out to determine this. If the site appeared to have a global target audience then the country of origin was noted as “worldwide”.

Only the initial webpage which appeared in the Google search was analysed. Internal links which expanded sections of the initial webpage were also analysed as were any videos found on the webpage. Links which led to other internal or external webpages were not analysed.

2.7 Readability analysis

All webpages were analysed for readability using three different tools: the F-K, SMOG and the FOG. A free online readability tool (http://www.online-utility.org/english/readability_test_and_improve.jsp) was used to calculate the (RGL) of each webpage using the three RGL formulas. This was done by copying and pasting the webpage's text into the tool. The tool then gave the three RGLs from each formula for the webpage. The RGLs were put into an Excel spreadsheet and the mean RGL was calculated for each webpage.

2.8 Plain language analysis

The plain language of each webpage was assessed using a checklist based on two separate tools, which was formed by revising and combining the checklist for plain language on the web (Plain Language Action and Information Network, 2020) and the quick checklist for plain language (Centre for health literacy, 2020). This checklist was revised by members of the research team. Each webpage received a score for plain language and it ranged which was scored out of 20. This score was recorded in an Excel spreadsheet.

2.9 Content Assessment

The content of each webpage was assessed using both the PEMAT and the DISCERN. This was also cross checked by another member of the research team to ensure inter-rater reliability. The second rater also performed the PEMAT and DISCERN a random selection of 20% of the webpages. The PEMAT was revised by the research team to minimise discrepancies between raters and in scoring of different webpages. The DISCERN was already revised by a former researcher (Strathdee-Goomes, 2019).

A random selection of 19 webpages were initially rated by both the primary researcher and other members of the research team who were randomly assigned to different webpages. This equated to a total of 7 different researchers rating at least 1 of the initial 19 webpages. The scores for the PL, PEMAT and DISCERN were analysed between the primary researchers rating and the other researcher's rating by calculating the intraclass correlation coefficient (ICC) (Fleiss, Levin, & Paik, 2013).

2.9.1 PEMAT

The PEMAT tool assesses the understandability and actionability of patient education materials. The PEMAT was designed to assess whether patients can understand and then act on the given information. One benefit of PEMAT is that it is able to be used to assess the content of videos unlike many other tools.

The PEMAT was scored in two separate sections. The “understandability” section and the “actionability” section. Each statement was graded as agree (1 point), disagree (0 points) or N/A. The total points a webpage scored was summed and divided by the total available points (every statement which did not receive an N/A) and times by 100 to generate a score

as a percentage. In the study every webpage was assessed using the PEMAT checklist and scored accordingly. The score was then put into an excel spreadsheet.

2.9.2 DISCERN

The DISCERN tool assesses the reliability of content of health information. In particular the DISCERN can be used to assess the accuracy of the content and is specifically designed to assess the treatment options provided in online health information. Unlike other tools the DISCERN does not assess the layout or graphics of the health information. In this study the DISCERN tool was used to assess the reliability of the health information found online, irrespective of whether the information contained a treatment option or not. The score for each webpage was then put into an Excel spreadsheet.

2.9.3 HONcode

The HONcode verification was used to assess the quality of webpages. Webpage creators can choose to get certification from HONcode. To check whether the webpages were HONcode certified the URL was entered into the HONcode search bar (<https://www.hon.ch/HONsearch/Patients/index.html>), which only shows results from HONcertified sites.

2.10 Data Analysis

In this study there were four dependent variables which were the plain language scores, RGL, DISCERN and PEMAT scores. There were 3 independent variables which were HON code

certification, country of origin and type of organisation that produced the online material. For analysis purposes for the country of origin was divided into three groupings, Americas, World and Other. This was done to ensure data analysis gave an even distribution of data.

Data analysis was performed using IMB SPSS 25. The assumptions of normality were tested. The data met parametric assumptions. The descriptive statistics used were ICC, Chi-square test, analysis of variance (ANOVA), and Pearson's correlation coefficient and an alpha level of 0.05 was used.

Chapter 3: Results

3.1 Overview

This study examined the suitability and readability of online health information relating to SSNHL in English. Firstly, the RGL level was calculated using the FOG, SMOG and F-K, to create a mean-RGL using a mean of the three RGL tools. Secondly, the material was analysed using the PEMAT, plain language analysis and the DISCERN tools. Each URL was checked to see if it was HONcode certified which measured the quality of the content. Ethics was approved by the University of Canterbury human ethics committee on 8th April 2019. The survey used to derive search terms, as described in section 2.2, had a total of 17 people respond, with ages of the participants ranging from 22-63 years. Nine of the participants had an education level which was bachelor's degree or above.

3.2 Descriptive Statistics

3.2.1 Region and Type of Organisation

Each webpage was coded by both location of origin and type of organisation. Originally the locations were grouped as Africa (n = 6, 14.6%), Americas (n = 15, 35.6%), Europe (n = 6, 14.6%), Asia (n = 0, 0%), Eastern Mediterranean (n = 0, 0%), Pacific (n = 12, 29.3%) and World (n = 2, 4.9%). Due to the uneven distribution of webpages within these original locations, these regions were collapsed into three locations which were: Americas (n = 15 36.5%), Western Pacific (n = 12, 29.3%) and Rest of the World (n = 14, 34.1%).

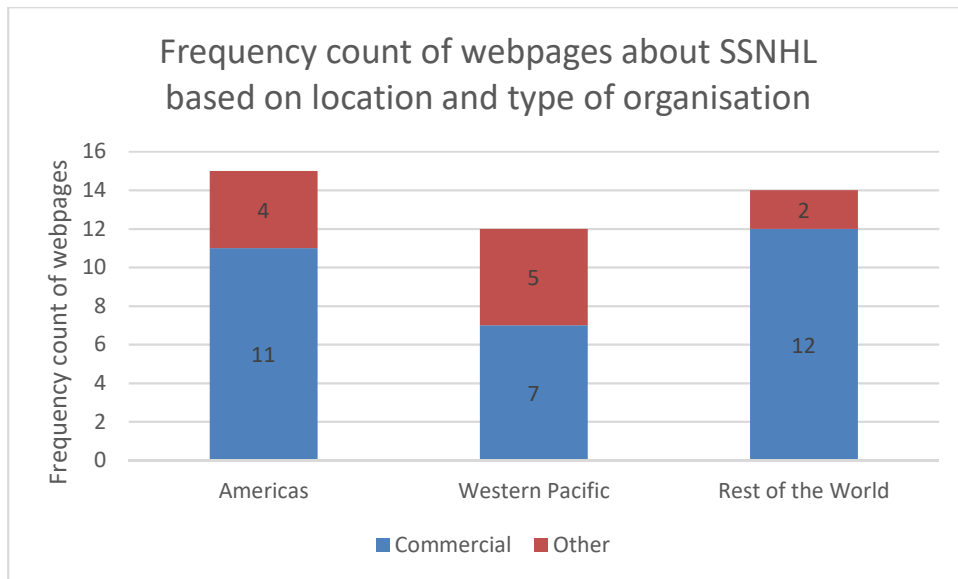


Figure 1: The distribution of webpages relating to SSNHL based on region and type of organisation

Type of organisation was grouped into three variables originally, however there was an uneven distribution with the majority organisations being “commercial” ($n = 30$, 73.2%), with the remainder consisting of government ($n = 5$, 12.2%) and “other” ($n = 6$, 14.6%). Due to this the “government” and “other” groups were collapsed to become “other” (26.8%). The frequencies of the regrouped groups can be seen in Figure 1.

Table 2: Mean and standard deviation (SD) of tools used to assess webpages in relation to SSNHL

	Understandability	Actionability	Plain Language	DISCERN	Mean-Reading grade level
Classification	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Americas	71.06 (16.98)	38.22 (23.67)	14.8 (4.23)	2.87 (1.12)	11.89 (2.31)
Western Pacific	67.11 (15.67)	37.78 (26.26)	14.83 (3.51)	2.08 (1.24)	10.85 (2.36)
Rest of the World	68.11 (18.29)	27.14 (23.95)	15.15 (3.46)	2.15 (1.07)	9.91 (1.68)
Commercial	65.51(17.52)	31.22 (23.95)	14.31 (3.74)	2.21 (1.15)	11.02 (2.56)
Other	78.15 (10.09)	39.09 (24.04)	16.55 (3.14)	2.91 (1.14)	10.60 (0.98)

The means and standard deviations were analysed for each tools scores. These values can be seen in Table 2.

3.2.2 HONcode Certification

Of the 41 webpages, just four webpages (9.8%) were HONcode certified. Three of the HONcode webpages were “commercial” (75%) and the other one was “other”. This is similar to the proportion of webpages that were “commercial” (73.2%) and “other” (26.8%). Due to the small sample size of webpages which had HONcode certification, the null hypotheses which relating to HONcode certification were removed.

3.2.3 Readability

Three different readability formulae were used to calculate the average RGL. These were the FOG, SMOG and F-K. When looking at the FOG, the RGL ranged from 6.41-17.49 ($M = 11.46$, $SD = 2.51$). The RGL when using the SMOG ranged from 7.52-15.78 ($M = 11.09$, $SD = 1.91$). The RGL when using the F-K ranged from 5.00-16.96 ($M = 10.17$, $SD = 2.43$). For analyses purposes the mean of the FOG, SMOG and F-K was used, the mean-RGL ranged from 6.31-16.58 ($M = 10.91$, $SD = 2.24$).

3.2.4 ICC

The ICC is a widely used measure of inter-rater reliability for quantitative ratings. The inter-rater agreement for the total scores was high. An ICC measure above .750 shows excellent agreement beyond chance (Fleiss et al., 2013). The ICC single measures for actionability, understandability, plain language and DISCERN were .892, $p < .001$; .895, $p < .001$; .921, $p < .001$; .855, $p < 0.001$, respectively. This shows that all ICC measures for each tool showed excellent agreement beyond chance.

3.2.5 PEMAT

While the PEMAT is one tool, it is broken into two components: Understandability and actionability. Therefore, each component has been analysed separately. Understandability scores ranged from 33% to 94% ($M = 69\%$, $SD = 17\%$). Table 3 provides a summary of the frequency of understandability scores for each factor for the materials assessed and Table 4 provides a summary of the frequency of actionability scores for each factor for the materials assessed. The PEMAT assesses both print and audio/visual materials. Some of the statements in the PEMAT checklist also rate specific aspects which could be present in the material and have NA as an option if the material does not contain that aspect. For these two reasons, there is variability in the sample sizes for each PEMAT (both understandability and actionability) question.

Table 3: Summary and frequency of webpages scores on individual understandability questions

Understandability		% of Webpages
Content		
1	The material makes its purpose completely evident* [^]	75.61% (n = 41)
Topic: Word choice and style		
2	Material does not include information or content that distracts from its purpose*	78.1% (n = 41)
3	The material uses common, everyday language * [^]	51.2% (n = 41)
4	Medical terms are used only to familiarize audience with the terms * [^]	48.8% (n = 41)
5	The material uses the active voice * [^]	58.5% (n = 41)
Topic: use of numbers		
6	Numbers appearing in the material are clear and easy to understand *	82.9% (n = 41)
7	The material does not expect the user to perform calculations *	92.7% (n = 41)
Topic: Use of numbers		
8	The material breaks or "chunks" information into short sections * [^]	92.7% (n = 41)
9	The material's sections have informative headers * [^]	71.8% (n = 39)
10	The material presents information in a logical sequence * [^]	87.8% (n = 41)
11	The material provides a summary * [^]	56.4% (n = 39)
Topic: Layout and design		
12	The material uses visual cues to draw attention to key points * [^]	53.7% (n = 41)
13	Text on screen is easy to read [^]	NA
14	The material allows the user to hear the words clearly [^]	100% (n = 1)
Topic: Use of visual aids		
15	Visual aids used whenever they could make content more easily understood *	17.5% (n = 40)
16	The material's visual aids reinforce rather than distract from the content*	75.0% (n = 12)
17	The material's visual aids have clear titles or captions*	33.3% (n = 12)
18	The material uses illustrations and photographs that are clear and uncluttered * [^]	83.3% (n = 12)
19	The material uses simple tables with short and clear row and column headings * [^]	25.0% (n = 12)

* = print, [^] = A/V

Table 4: Summary and frequency of webpage scores on individual actionability questions

	Actionability	% of Webpages
20	The material clearly identifies at least one action the user can take * [^]	68.3% (<i>n</i> = 41)
21	The material addresses the user directly when describing actions * [^]	34.1% (<i>n</i> = 41)
22	The material breaks down any action into manageable, explicit steps * [^]	39.0% (<i>n</i> = 41)
23	Material provides a tangible tool whenever it could help the user take action *	2.4% (<i>n</i> = 41)
24	Eexplains how to use the charts, graphs, tables, or diagrams to take actions * [^]	0% (<i>n</i> = 10)
25	Uses visual aids whenever they could make it easier to act on the instructions*	2.4% (<i>n</i> = 41)

* = print, [^] = A/V

Actionability scores ranged from 0% to 80% ($M = 33\%$, $SD = 24$). Table 4 provides a summary of the frequency of actionability scores for each factor for the materials assessed.

3.2.6 Plain language

Plain language scores were based on yes or no to the following questions as displayed in Table 5 below. The final question (number 20), is related to images. If a webpage contained no images it got a 0 for that question. Plain language scores ranged from 7/20 to 20/20 ($M = 15$, $SD = 4$). Table 5 provides a summary of the frequency of understandability scores for each factor for the materials assessed.

Table 5: Summary and frequency of webpage scores on individual Plain language questions

Question	% of Webpages
Reader Focus	
Does one or more of the headings contain the topic of interest?	100% (<i>n</i> = 40)
Does the introduction (first paragraph) inform the reader what they are about to read?	70% (<i>n</i> = 28)
Is the content relevant to the topic of interest?	90% (<i>n</i> = 36)
Organisation	
Does the material begin with the most important message of that webpage/video?	82.5% (<i>n</i> = 33)
Is the content arranged in a sensible order?	97.5% (<i>n</i> = 39)
Are different topics grouped under separate headings or subheadings?	82.5 (<i>n</i> = 33)
Writing	
Are personal pronouns such as “you” and “we” used throughout?	32.5% (<i>n</i> = 13)
Is an active voice used throughout?	62.5% (<i>n</i> = 25)
Are lay terms predominately used throughout?	60% (<i>n</i> = 24)
If technical terms are used, are they explained?	50% (<i>n</i> = 20)
Are simple sentences used throughout (i.e. no more than one new idea per sentence)?	55% (<i>n</i> = 22)
Is correct grammar used throughout?	87.5% (<i>n</i> = 35)
Is correct punctuation used throughout?	87.5% (<i>n</i> = 35)
Are unnecessary words eliminated (e.g. technical jargon or adverbs)?	40% (<i>n</i> = 16)
Design & Formatting	
Is the appearance of the material consistent throughout (i.e. consistent use of fonts, italics, bold print, colour, and bullet points)?	95% (<i>n</i> = 38)
Does the material look easy to read, with an uncluttered layout, plenty of white space, and dark text on a light background or light text on a dark background?	92.5% (<i>n</i> = 37)
Are the fonts clean in their design and easy to read (not fancy or unusual, e.g. Arial)?	97.5% (<i>n</i> = 39)
Is the text size large enough for easy reading and does each line have about 10-15 words?	85% (<i>n</i> = 34)
Are italics, underlining, capitalisation, and bold print used sparingly?	100% (<i>n</i> = 40)
Are images clear and uncluttered and related to the content?	27.5% (<i>n</i> = 11)

3.2.7 DISCERN

Understandability scores ranged from 1/5 to 5/5 ($M = 2.4$, $SD = 1.2$). The inter-rater agreement for the total scores was high.

3.3 Hypothesis Testing

3.3.1 Normality

It was assumed that there was normal distribution due to the size of the sample size ($N=41$). The central limit theorem applied to the distribution. There were no significant outliers. It was determined that parametric test assumptions were met.

3.3.2 Distribution based on Region and Type of Organisation

The study aimed to examine the following hypotheses:

- 1a) There is an even distribution of webpages on SSNHL based on type of organisation.
- 1b) There is an even distribution of webpages on SSNHL based on locality of organisation.

To determine the distribution of online information relating to SSNHL based on the type of organisation and locality of organisation, two separate chi-square tests of independence were performed.

There was an even distribution based on region $\chi^2 (2, N = 41) = .341, p = .101$. A chi-square test of independence was performed to examine the distribution of NIHL online information from different types of organisations.

There was an uneven distribution based on type of organisation $\chi^2 (1, N = 41) = 8.805, p = .003$.

Based on the above analysis the null hypothesis "There is an even distribution of webpages on SSNHL based on type of organisation" was not supported.

3.3.3 Mean RGL

2a) Is the mean RGL significantly different from the recommended RGL for health-related material is 6 or below?

A one sample t-test was performed to compare the mean RGL with the RGL of six, which found that the mean RGL was significantly greater than 6, $t(14.02) = 10.91, p < .001$.

Based on this analysis the null hypothesis is not supported

2a) There are no significant differences in mean RGL of webpages on SSNHL based on type of organisation.

2b) There are no significant differences in mean RGL of webpages on SSNHL based on locality of organisation.

A two-way ANOVA was performed to determine whether there were any significant differences in the mean RGL of webpages on SSNHL based on the type of organisation and locality of organisation.

The assumptions of the ANOVA were met including the assumption of equal variance. This was confirmed by performing a Levene's test which was not significant.

There were three levels of regions which were defined as Americas, Pacific and rest of the world; there were two levels of organisations which were defined as "commercial" and "other". There were no significant interactions $F(2, 35) = .880, p = .183$, and the main effects were examined. There was no significant difference in RGL based on type of organisation $F(1, 35) = .47, p = .50, \eta_p^2 = .013$ or based on location $F(2, 35) = 1.30, p = .28, \eta_p^2 = .069$

Therefore, the null hypotheses above are supported, there are no significant differences between mean RGL based on the type of organisation and location.

3.3.4 DISCERN

3a) There are no significant differences in mean DISCERN scores of webpages on SSNHL based on type of organisation.

3b) There are no significant differences in mean DISCERN scores of webpages on SSNHL based on locality of organisation.

There was no significant interactions $F(2, 34) = .796, p = .534$, and the main effects were examined. There were no significant differences in the DISCERN scores based on the type of organisation $F(1, 34) = 3.648, p = .065, \eta_p^2 = .097$ and locality $(2, 34) = 2.165, p = 0.88, \eta_p^2 = .13$.

Both hypotheses above relating to DISCERN scores were supported.

3.3.5 PEMAT

The PEMAT consists of two sections – understandability and actionability as seen in Table 3 and Table 4. Therefore, for the purpose of this analysis each section was treated as two separate sections, rather than a single tool.

4 ai) There are no significant differences in mean understandability scores of webpages on SSNHL based on type of organisation.

4 aii) There are no significant differences in mean understandability scores of webpages on SSNHL based on locality of organisation.

A two-way ANOVA was performed for the understandability section of the PEMAT there were no significant interactions $F(2, 35) = .278, p = .759$, and the main effects were examined. The main effect for region yielded an F ratio of $F(2, 35) = .653, p = .527, \eta_p^2 = .036$, indicating there was not a significant difference in understandability scores between Americas ($M = 71.06, SD = 16.97$), Western Pacific, and Rest of the World ($M = 68.11, SD = 16.73$). The main effect for type of organisation yielded an F ratio of $F(1, 35) = 5.35, p = .027, \eta_p^2 = .133$, indicating there was a significant difference in understandability scores between “commercial” and “other” with “commercial” having a significantly lower score for understandability than “other”.

Based on these results the hypotheses above are supported.

4bi) There are no significant differences in mean actionability scores of webpages on SSNHL based on type of organisation.

4 bii) There are no significant differences in mean actionability scores of webpages on SSNHL based on locality of organisation.

A univariate ANOVA was performed for the “actionability” section of the PEMAT there were no significant interactions $F(2, 35) = 2.509, p = .096$, and the main effects were examined. The main effect for region yielded an F ratio of $F(2, 35) = .186, p = .831, \eta_p^2 = .010$, indicating there was not a significant difference in actionability scores between Americas ($M =, SD =$), Western Pacific ($M =, SD =$), and Rest of the World ($M =, SD =$). The main effect for type of organisation yielded an F ratio of $F(1, 35) = .724, p = .401, \eta_p^2 = .020$, indicating there was no significant difference in actionability scores between “commercial” and “other”.

Based on these results the hypothesis “There are no significant differences in mean actionability scores of webpages on SSNHL based on type of organisation” is not supported

while the hypothesis “There are no significant differences in mean actionability scores of webpages on SSNHL based on locality of organisation.” is supported.

3.3.6 Plain language

5a) There no significant differences in mean Plain Language scores of webpages on SSNHL based on locality of organisation

5b) There no significant differences in mean Plain Language scores of webpages on SSNHL based on locality of organisation

A univariate ANOVA was performed for the mean PL scores; there were no significant interactions $F(2, 34) = .820, p = .695$, and the main effects were examined. The main effect for region yielded an F ratio of $(2, 34) = .367, p = .695, \eta_p^2 = .021$, indicating there was not a significant difference in actionability scores between Americas, Western Pacific, and Rest of the World. The main effect for type of organisation yielded an F ratio of $F(1, 34) = 3.392, p = .074, \eta_p^2 = .091$, indicating there was a significant difference in understandability scores between “commercial”, and “other”

Based on these results the null hypotheses relating to plain language scores are supported.

3.4 Summary of Results

The data did not violate any of the assumptions for normality for parametric testing, therefore parametric analysis was used. Hypotheses regarding the HONcode were removed from the statistical analysis as there was not an even distribution of webpages which did and did not have HONcode certification. All of the null hypotheses were supported, except for three;

There is an even distribution of webpages on SSNHL based on: type of organisation; The mean RGL is not significantly different from the recommended RGL for health-related material is 6 or below; There are no significant differences in mean actionability scores of webpages on SSNHL based on type of organisation.

Chapter 4: Discussion

4.1 Overview

This study aimed to examine the readability and suitability of online health material in English relating to SSNHL. The results found that the mean readability of online information relating to SSNHL was high while the suitability was variable depending on the tool used, but generally poor. This chapter will discuss these results in more detail in relation to these results compared to other studies as well as make recommendations for improvement.

This study also assessed the impact which location and type of organisation had on the readability and suitability of online SSNHL information. There were significantly more webpages written by “commercial” authors compared with “other” organisations. There were no differences in the distribution of webpages based on location. Understandability was significantly higher on webpages from “commercial” sources. These findings will be discussed in this chapter along with the clinical implications of this research. The limitations of this study will also be discussed.

4.2 Readability of online SSNHL information

The results from this study found that the readability of SSNHL webpages was high. The recommended AMA guidelines for RGL for health information is six or below (Weiss, 2003), however none of the webpages had an RGL score of 6 or below, with the mean RGL score for all webpages being 10.91. This is supported by the literature where it is commonly seen that online health information is at an RGL much greater than 6 (McInnes & Haglund, 2011). This is including online health information related to hearing loss which has been found to have RGLs ranging from 9-14 (Elmadani, 2019; Laplante-Lévesque & Thorén, 2015; Potter, 2015).

4.3 Suitability of Online SSNHL Information

4.3.1 Strengths and Weaknesses Identified by PEMAT

The PEMAT assess both written as well as audio/visual items. While this tool was used to assess an audio item in this study there was only one audio webpage that came up in the search for SSNHL online information and therefore will not be discussed in great detail.

The mean score for understandability was 69%. This score is higher than that found by Balakrishnan, Chandy, Hseih, Bui, and Verma (2016) who had a mean of 53%, yet lower than that found by (Harris et al., 2018) who had a mean of 81.9%, who examined the understandability of online material relating to vocal cord paralysis materials and online material relating to tympanostomy tube placements respectively. This score was much lower than found by mean plain language score was 15/20, which equates to 75%, this is close to the understandability score of 69%, which would be expected as the PL checklist looks at similar aspects of understandability.

The understandability of “commercial” webpages relating to SSNHL was significantly lower than that of webpages from “other” sources. While other research has found that the quality of commercial webpages is lower than that of governmental (Dueppen, Bellon-Harn, Radhakrishnan, & Manchaiah, 2019) this has been shown using the DISCERN as the tool, not the PEMAT. Other research which has looked at the understandability of health information using PEMAT has found no difference in the understandability between information from commercial or governmental sources (Brütting et al., 2019). The “other” component was comprised of all non commercial sources, including government and not for profit webpages.

4.3.1.1 PEMAT – Content (Understandability)

The PEMAT examined factors which included: purpose information or content that distracts from its purpose; everyday language; use of medical terms; and the use of active voice. The majority of the webpages contained a statement which defined the purpose of the webpage (75.6%) and did not contain any information that distracted from the purpose of the webpage (78.1%). This is important for readers as they need to be aware of what the following information is so that they can make a decision as to whether that information will be beneficial to them in making health related choices.

Unfortunately, the other parts of webpage content which were assessed by the PEMAT were not rated as highly. Only around half of webpages used common everyday language (51.2%) and only used medical terms to familiarize the audience with the terms (48.8%). This can result in readers being overwhelmed by reading uncommon language, and not being able to comprehend the information being given (Deuster, Christopher, Donovan, & Farrell, 2008). However, online forums which contain higher amounts of medical jargon have been associated with a higher level of credibility with users (Zimmermann & Jucks, 2018). While it is important that health information is credible to users, it is important that there is not so much jargon that makes the information hard to understand which could result in negative health outcomes for some people.

The PEMAT found that overall the organization of the webpages was relatively good. Most webpages broke down the information into short sections and presented the information in a logical sequence. However just over half of webpages provided a summary at some point on the webpage. A summary helps the reader by summarising and focussing on the most important parts of the webpage, including any take home messages. This can increase engagement, however it is important that the summary is simplified (Jiggins, 2016).

4.3.1.2 PEMAT – Content (Actionability)

The PEMAT tool also assesses the actionability of the webpages, this is defined as “when consumers of diverse backgrounds and varying levels of health literacy can identify what they can do based on the information presented” (Shoemaker et al., 2014). There was no difference in the actionability scores between origin of webpage or by type of organisation. The mean score of 33% for actionability is relatively low, however this is not uncommon when assessing health related webpages (Harris et al., 2018) and is very similar (34%) to that found by Ruble, Paré-Blagoev, Cooper, and Jacobson (2019) who examined the quality of online information relating to child cancer treatment.

The main strength in terms of actionability was that most webpages (68.3%) identified at least one action that the user could take. It is worth noting however that this may have been only one action and not necessarily have given the user options as is best practice with regards to patient centred care and shared decision making (Elwyn et al., 2013). Almost none of the webpages (2.4%) provided a tool to help the user take action or used visual aids to make it easier to act on instructions. Both of these may help users who are more visual learners.

4.3.2 Strengths and Weaknesses Identified by PL

As the PL is not a validated tool there is no literature on this topic. However, there were strengths and weaknesses which were identified by the PL in relation to the webpages on SSNHL. The mean score for webpages for the PL was 15/20. This is an adequate score with three quarters of the targets being met, on average.

The strengths that were identified by the plain language tool were headings, the design and formatting of webpages and the organisation of the webpages. All of the webpages contained at least one heading which contained the topic of interest. This is helpful for users to decide whether the following webpage they have found will be relevant to them. Following from this, the webpages were well organised and the content was generally arranged in a sensible order (97.5%). The formatting also tended to be well done, with the majority of points being met by most webpages such as consistent use of fonts (95%), italics used sparingly (100%) and using fonts which were clean in their design (97.5%). These features as identified by the PL tool help users to navigate a webpage more easily, although the PL does not examine the factuality of content.

While the PL tool rated most webpages positively overall, there were a few areas within the that were consistently inadequate. If images were present, they were not always related to the content with just 27.5% of webpages which had images containing related images. While a picture may add some interest to a piece of text, if it is not relevant it is not helping the user to identify the purpose of the text nor helping them to understand the text.

Another weakness identified by the PL tool was that personal pronouns such as you and we were not used very commonly. Just 32.5% of webpages used personal pronouns throughout the text. The PL tool also identified that a large number of webpages (60%), contained unnecessary jargon. This can negatively impact the readers understanding of a piece of text especially if they are not familiar with the particular medical terms.

4.3.3 Strengths and Weaknesses Identified by DISCERN

The DISCERN is a commonly used tool to assess the quality of health-related information, which particularly focuses on treatment options. A rating of 1 (low) is described as “serious

or extensive shortcomings”, a rating of 3 (moderate) is described as “potentially important but not serious shortcomings” and a rating of 5 is described as “minimal shortcomings”. The mean rating for the DISCERN of the webpages was 2.4 out of 5. This is closest to being described as “serious or extensive shortcomings”. While some webpages did score a 5/5 others only scored a 1 – the lowest possible score. One of the most common shortfalls from the DISCERN was that webpages did not describe all of the treatment options, especially the option of no treatment. As with all patient centred care, the patient has the right to be made aware and educated of all the treatment options available to them as well the risks and benefits of each treatment option. Similarly, most webpages did not refer the person to other services of support other than themselves. Both shortfalls are likely in part due to a lot of the webpages being “commercial” which only offered their own services and did not mention any other options (DeCamp, 2013). However, this is still not acceptable if it is designed to be a source of information for a patient who has a SSNHL.

Another weakness of the webpages as identified by the DISCERN was that many webpages did not identify where their sources were from, and did not have any reference as to where the user could go for further research.

A strength as identified by the DISCERN was that most webpages made the aim of their page clear. This is beneficial so that the patient can identify whether a webpage will be helpful or relevant to themselves.

4.4 Region and Type of Organisation

From the results there were no differences in the distribution of webpages based on origin once these were regrouped. However, before these were regrouped there were significantly more webpages which were from the America’s region. The type of origin was regrouped

into “commercial” and “other”, however there were still an uneven distribution, with a greater proportion of webpages which were deemed “commercial” in origin compared with those grouped into “other”. This was also experienced by Manchaiah et al. (2019) who found that when examining webpages on tinnitus that nearly half (49.3%) of the webpages were in origin. This increased number of “commercial” health related webpages is likely due to multiple factors. Firstly, there is a larger number of commercial organisations compared with government or not for profit organisations which composed of the “other” grouping. Secondly, commercial pages are trying to be profitable and therefore it is likely that they will create a webpage to support their business which results in bias or a conflict of interest (DeCamp, 2013).

The webpages from the “other” grouping had mean higher scores for all the tools which were used to assess the webpages as well as a lower mean RGL. While only understandability was significantly worse for “commercial” webpages compared with “others”, this demonstrates a trend that the webpages from other sources tended to be more suitable and more readable than those written by commercial organisations. This is supported by the literature where not for profit hearing related webpages tend to have significantly higher scores when using the DISCERN compared with commercial webpages (Laplante-Levesque et al., 2012). However, both Manchaiah et al. (2019) and Elmadani (2019) who looked at online hearing information on tinnitus and NIHL respectively found no significant differences in suitability based on location or type of organisation.

4.5 Clinical Implications

As it is likely that if a person who develops a SSNHL and seeks treatment within the first 48 hours is more likely to regain some of their hearing than a person who does not seek

treatment(George & Pradhan, 2009). A large number of individuals seek out medical information online (Sillence et al., 2007), including individuals whose health concern is hearing loss (Peddie & Kelly-Campbell, 2017). Often going online is the first point of calls for individuals before seeking out professional medical advice (Graffigna, Barelllo, Bonanomi, & Riva, 2017). If a person seeks out SSNHL information online and the urgency is not emphasised or the information to seek medical help is not given, they may just wait until the next available appointment or assume it is something benign such as a cold which is causing the hearing loss. If a person has low functional health literacy skills, they may not be able to interpret the information given on the webpage. Due to the time pressures of this condition it is vital that health information relating to this condition is clear, accurate, and easy to understand for the general public, including at an appropriate RGL. As the internet is so accessible nowadays, including in New Zealand especially on mobile devices(Stats NZ, 2017), it has the potential to be a great resource for individuals who find themselves with a SSNHL. However, based on the results of this study webpages relating to SSNHL have a high level of readability and have poor to adequate levels of suitability. These results are in line with the current literature on online based hearing related information (Elmadani, 2019; Laplante-Levesque et al., 2012; Potter, 2015; Strathdee-Goomes, 2019). Therefore, for this resource to be effectively utilised the content available should be improved. This is the responsibility of web-developers, corporations and audiologists.

4.6 How to Improve Online SSNHL Information

Below (Table 6) are some recommendations to improve the quality of webpages related to SSNHL which are based from the results of the tools used to assess the SSNHL webpages. The RGL should also be reduced a substantial amount.

Table 6: Recommendations to improve quality of webpages

Factor	Recommendation
RGL	Writing at or below 6 th level
Medical terms are used only to familiarize audience with the terms	Only use medical and technical terms when required to adequately explain something. If used, explain meaning
The material uses common, everyday language	Use common everyday language, including syntax and commonly understood words
Use of active voice	Use active voice through entire piece of information where possible.
Use of personal pronouns.	Use words such as “you”, “them”, “they” throughout. This is especially important when discussing action options. The user should be addressed directly
The material provides a summary	Provide a summary of key points including next steps to take and treatment options. This can either be at the end of each section or at the end of the webpage
Use of visual aids	Visual aids used whenever they could make content more easily understood and must be related to the content
The material uses simple tables with short and clear row and column headings	If tables are used, they need to be labelled, short and simple to understand. Numbers should be kept to a minimum in health-related information
Use of tools to aid user is decision making	Material provides a tangible, relevant tool whenever it could help the user take action
It is clear what sources other than the author or organisation were used to compile the information	Credible sources other than associated sources should be used and referenced. In text and a bibliography are both required so that user can do further research
It is clear there is more than one treatment choice	All possible treatment options should be at least mentioned including the choice of no treatment option. Optimally treatment options should be described.
The risks and benefits of each treatment choice is described	Clearly describe the risks and benefits of each treatment option.

4.7 Recommendations for Health Care Professionals & corporations

Health care professionals such including audiologists, ear nose throat doctors or general practitioners, may at times be required to contribute to a webpage (or other written source of health information) or refer a patient to sources of information such as the internet in relation to a SSNHL.

If this is asked of a health care professional, then they need to ensure they are competent enough to provide this information and ensure they are giving evidence based

information that is easy to understand for the general public. A health care professional could have a list of sites that patients could visit which have met a certain criterion. Health care professionals could also advise of the HONcode certification.

While the internet is an important source of information which a lot of people with HL use to seek information (Graffigna et al., 2017), verbal information from a health care professional can also be very valuable. Health care professionals are able to directly answer questions, give relevant appropriate information as well as refer on as necessary.

4.8 Limitations of Readability Formulas

Readability formulas only take into account textual factors (Redish, 1981), and therefore should not be the only tool used to assess the quality of online health information relating to SSNHL. An RGL score does not measure whether the text is comprehensible, nor whether it is relevant to the topic being researched or even if the text is factual (Oakland & Lane, 2004). One factor to consider is the scoring of the RGL formulas. While a piece of text with many short sentences may receive a lower RGL score, it may be less comprehensible compared with a text which has longer more cohesive sentences (Redish, 1981).

Certain medical terms or words cannot be shortened or described in any other way before the text loses its meaning and therefore the RGL can be high. For example, sudden sensorineural hearing loss is the correct terminology of the condition, however using this terminology would increase the RGL score (Crossley, Skalicky, & Dascalu, 2019). While this could be considered medical jargon, the reader will be exposed to these terms and adapt and understand the terms.

Another factor that is not taken into account with readability formulas is the individualities of the reader. For example, the reader may already have researched the topic and have some prior knowledge or may be a health professional themselves (Crossley et al.,

2019; Jindal & MacDermid, 2017). For this reason, the AMA recommendation of an RGL <6 should not be too heavily weighted when analysing online health material.

4.9 Study Limitations and Future Research

Initial search results yielded skewed distribution of webpages of both type of organisation and location of the webpage. The original study design aimed to compare three types of organisations as well as seven different locations as outlined in section 2. However, these groupings had to be collapsed due to the small sample sizes which limited the data analysis as certain groups and locations could not be compared.

Another limitation was that there was a high percentage (73.2%) of “commercial” webpages from the data collection. Often commercial webpages are offering a particular (profitable) service or something similar. Therefore, they may not describe the whole range of treatments available. As so many of the webpages were “commercial”, the mean scores may have been biased towards this. Perhaps in the future specifically “commercial” webpages should be compared separately to the “other” category. If a webpage is commercial it should be made known to the reader so they can assess the webpage understanding that not all treatment options may be presented.

There are also limitations of the tools which were used. For example, while the DISCERN focuses on treatment choices, it does not actually assess the quality of the treatment options. The webpage may have discussed treatment options which are not evidence based, but if the webpage described the options well enough then it could receive a good DISCERN rating. Similarly, the quality in terms of factualness or whether the information was evidence based was not rated in either the PL or the PEMAT. There are no validated tools to date which can rate this information. This would be a hard tool to develop

due to many variables. It would require webpages to be rated by experts in the field and would likely require multiple raters. This is something that could be developed or performed in the future.

Another limitation is that certain webpages are designed for a specific type of audience. For example, a journal article is usually written for professionals and academics who practice or research in a certain field, yet some journal articles appear in online searches which anybody can access. It would not be practical to write at a level that a member of the general public could understand as often journal articles are very detailed and specific. However, all webpages must be rated as they appear in a user's Google search. These types of webpages will likely bring down all ratings, especially RGLs. While it is not practical to write these types of articles differently, perhaps the editors of the journals or the authors of the articles could use a disclaimer saying who the intended audience of the webpage is. This was sometimes done by some of the hearing aid manufactures for example Phonak has a normal site as well as a "Phonak professional" site.

While efforts were made to reduce the variability of raters by using the ICC method as described in the methods it is likely that could still be some variability between and within raters at different times. To reduce this further, in future research there could be a minimum of two raters for all ratings and the mean used for all scores, as well as still incorporating the ICC measures.

While we were aiming to get a good spread of the general population for determining search terms used, the majority of respondents had a bachelors degree or higher. This is not a true representation of the general population (OECD, 2019). However, health seekers tend to be more educated and have a higher income compared with the general population (Cotten & Gupta, 2004) so this population may not be unlike that of a person who would use the internet

to find information. Participants were also entering search terms for something that unlikely has affected them which could bias the terms they gave.

Only Google was used for the purpose of this research. While there are other search engines that people use, such as Bing, Yahoo or others. Google is the most commonly used search engine in the world (Sharma, Gupta, Mateen, & Pratap, 2018). Therefore, for simplicity only Google was used in this study.

The PL was derived from checklist for plain language on the web and is therefore not a validated tool. While it was designed based off the checklist this tool itself has no test-retest reliability or validity. The ICC measured reliability however there is no established reliability or validity. The interpretation of the score is also qualitative as there has been no established criteria for interpreting the score. Therefore, results from the PL should be interpreted with some caution.

In the future, it could be beneficial to examine webpage from mobile devices as the number of internet connected mobile devices in New Zealand is increasing while the number of home broadband connections is decreasing (Stats NZ, 2017). This research could also be further continued by rewriting some SSNHL webpages and determining if a user found it more readable and understandable.

4.10 Conclusions

The use of the internet to seek health information is continually rising and is commonly the first place people seek health information from. This includes people searching the internet for information relating to hearing loss. There is a greater chance of hearing thresholds improving if treatment is sought as soon as possible following an episode of SSNHL. This research has found that online information relating to SSNHL has an RGL which is well above recommended and that most information is of poor to adequate suitability. Therefore,

people may not be able to understand and interpret online SSNHL information effectively enough to make informed decisions regarding SSNHL. There is a need for online SSNHL to be improved in relation to both readability and suitability so that individuals with SSNHL can have the best potential health outcomes relating to SSNHL.

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Appendix



HUMAN ETHICS COMMITTEE

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Email: human-ethics@canterbury.ac.nz

Ref: HEC 2019/07/LR

1 April 2019

Ana Blagojevic, Aynsley Hickson, Carol Hewitt, Katie Murphy, and Sarah Folkerts
Psychology, Speech and Hearing
UNIVERSITY OF CANTERBURY

Dear Ana, Aynsley, Carol, Katie, and Sarah

Thank you for submitting your low risk application to the Human Ethics Committee for the research proposal titled "Quality of Hearing-Related Internet Information".

I am pleased to advise that this application has been reviewed and approved.

With best wishes for your project.

Yours sincerely

A handwritten signature in black ink, appearing to be 'DS' followed by a stylized flourish.

Dr Dean Sutherland
Chair, Human Ethics Committee